# Chapter 9
# Species Composition and Use of Natural Salt Licks by Wildlife Inside a Production Forest Environment in Central Sarawak


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**Abstract** The island of Borneo is regarded as one of the most biologically rich regions in the world, containing some of the oldest remaining tropical rainforests. However, it also suffers high levels of deforestation and degradation to meet the demands for timber extraction and agricultural activities. In Sarawak, areas designated as permanent forests account for 35.2% of the total land area, much of which have already been opened up for timber extraction. In contrast, protected areas constitute less than 7% of the land area and are mostly sparsely distributed. Forests outside these protected areas are crucial for the conservation of wildlife. For long-term wildlife conservation to be effective, attention must be focused on how logging activities are carried out and how habitats for wildlife within these logging concessions are managed. This study was carried out in a logging concession in central Sarawak where sustainable forest management is practised. The objectives were to document the composition of wildlife, their use of key habitat sites and the effects of forest disturbance. Camera trapping exercises were carried out from August 2010 to November 2011. Preliminary results indicate that older logged-over areas contained higher diversity of animal species. Overall, 32 species of terrestrial mammals and ground-dwelling birds were recorded, of which 19 species were recorded to have visited salt licks. Ungulates were recorded visiting salt licks with the highest abundance. In forests that were logged 7 years ago and left to recover, the Borneo bay cat (*Catopuma badia*), a globally significant species, was recorded. This result

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indicates the importance of sustainable forest management and suggests some of the methods logging companies can undertake to conserve wildlife in a production forest environment.

**Keywords** Sarawak · Salt licks · Camera trap survey · Terrestrial mammals · Ground-dwelling birds

## 9.1 Introduction

The island of Borneo is regarded as one of the most biologically rich regions in the world, with high levels of endemism (MacKinnon et al. 1996; Wikramanayake et al. 2001). Tropical rainforests worldwide are rapidly disappearing as land is cleared for timber, agriculture, development and other uses (Meijaard et al. 2005; Meijaard and Sheil 2008). In the last three decades, Borneo has undergone high levels of deforestation and degradation, driven by the expansion of agricultural activities, forest conversion and logging (Curran et al. 2004; Langner et al. 2007). In the Malaysian state of Sarawak, less than 7% of the 12 million ha of the land area is protected. There are about 4.32 million ha or 35.2% of the land area that are designated as permanent forest estates. The current extent of terrestrial protected areas is never likely to be sufficiently large to protect viable populations of many wide-ranging and rare species (Bennett and Shebli 1999), such as the flying fox (*Pteropus vampyrus*), which covers extensive areas for feeding, even flying outside the boundaries of protected areas (Gumal et al. 2008). In contrast to production forests, totally protected areas are typically very small. The continued existence of wildlife will thus depend largely on how forests outside the totally protected areas are managed.

In Sarawak, logging has been and will continue to be a major economic activity. The export of logs from Sarawak accounts for huge proportion of Malaysia's total production, making the state a powerhouse for tropical log and timber production and earnings for the country. The export value of timber and timber products for Sarawak was RM5.9 billion (US$1.46 billion) in 2016 (though this figure is actually lower than those in the period 2012–2015) (STIDC 2016).

One of the key habitat areas for wildlife are natural salt licks, where minerals are deposited on the soil surface by spring water flowing through the soil. The distribution of some mammal species appears to be determined by the distribution of natural salt licks (Stark 1986; Payne and Andau 1991; Chanard et al. 1998; Laidlaw et al. 2000; Matsubayashi et al. 2007), and salt licks may affect movements and home ranges to some extent (Pages et al. 2005). The use of salt lick soils by wildlife has been shown to supplement poor nutrition (Holdø et al. 2000; Matsubayashi et al. 2007), to alleviate ailments (Mahaney et al. 1993, 1995a, b; Klaus et al. 1998;

Diamond et al. 1999; Krishnamani and Mahaney 2000), to absorb toxins and alkaloids from plant materials (Mahaney et al. 1995a; de Souza et al. 2002; Symes et al. 2006) or to alter food properties for easier digestion and palatability (Mahaney et al. 1995b; Diamond et al. 1999). In Deramakot Forest Reserve in Sabah, more than 78% of the known species that occur in the reserve were recorded to have visited salt licks for nutrient uptake (Matsubayashi et al. 2007). Salt licks are particularly important for herbivores and frugivores as they require sodium from naturally available resources, since plants are typically deficient in this element (Matsubayashi et al. 2007).

However, current knowledge of the use of salt licks by wildlife in Sarawak is still limited. Salt licks can easily be affected by logging activities, road construction or siltation from surface runoff. Forest managers who do not have adequate information on the protection of salt licks may inadvertently destroy them, affecting wildlife populations that use such resources in the forest.

## 9.2 Study Site

This study was carried out in a logging concession in central Sarawak. The site is called the Anap Sustainable Development Unit (ASDU) and encompasses 83,535 ha of logged natural forest, hereafter called the Anap-Muput Forest Management Unit (AMFMU). Some 19,270 ha (14,970 ha in the north and 4300 ha in the south) of the area are licensed for tree planting and a further 13,500 ha are government land. The AMFMU has begun its second cycle of harvesting, which started in 2000. In the early logging phase beginning in 1989, conventional logging methods were used before path logging methods were adopted under the Model Forest Management Area initiative by the International Tropical Timber Organisation in 1993, starting in coupe 15. A coupe is the annual operational area for the AMFMU. The reduced-impact logging (RIL) method was introduced in 2007 from coupe 6 onwards when the sustainable forest management exercise in preparation for certification was carried out.

In the AMFMU, riparian strips are protected and marked as stream bank reserves, which are at least 20 m wide. Sites such as naturally occurring salt licks are also protected. There are three known salt lick sites in the ASDU: Apan Sebedi, Apan Malat and Apan 11 (Fig. 9.1). *Apan* is the local term for salt licks. These salt licks are situated in forests with different periods of recovery after logging. Apan Sebedi is located in coupe 1, which was last logged in 2006. This site was earmarked for conversion into a tree plantation. Apan Malat is located in coupe 4, which was last logged in 2003. Apan 11 is named after coupe 11, which was last logged in 2010.

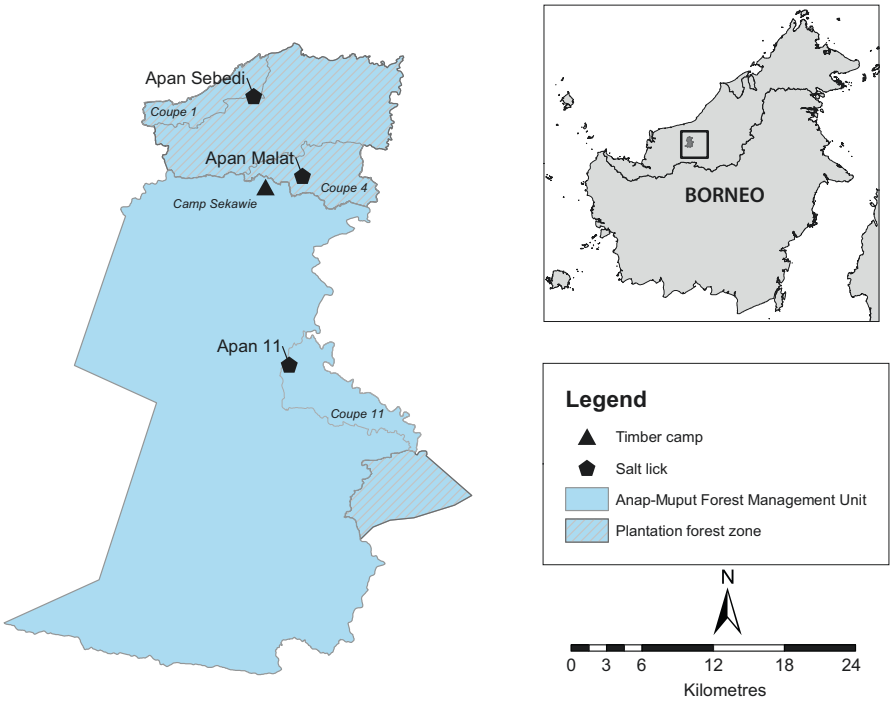


**Fig. 9.1** Location of salt licks
*Note*: inset shows the location of the study site in Borneo

## 9.3 Methodology

Three plots were selected—Apan Sebedi, Apan Malat and Apan 11 (Table 9.1)—named after their respective salt licks. These salt licks are situated next to streams. Automatic trigger cameras, also known as camera traps, were set up along a linear transect from a salt lick to a point located 2 km from the salt lick, at intervals of 200 m. For each study plot, the distance from the respective stream edge to the respective salt lick point was standardised for all camera trapping points along the transect. The type of camera used was a Bushnell Trophy Cam, which captured

**Table 9.1** Site description of study plots

| Name of plot | Location | Vegetation type | Surrounding area last logged (year) | Remarks |
|---|---|---|---|---|
| Apan Sebedi | Coupe 1 | Riparian; mixed dipterocarp forest | 2006 | Stream bank reserve |
| Apan Malat | Coupe 4 | Riparian; mixed dipterocarp forest | 2003 | Stream bank reserve |
| Apan 11 | Coupe 11 | Riparian; mixed dipterocarp forest | 2010 | Stream bank reserve |

colour and infrared images in digital format. The cameras were revisited between 1 and 5 months after they had been set up. The total sampling effort was 9270 camera trap days.

## 9.4 Results

The total number of terrestrial mammals, primates and medium- to large-sized ground-dwelling birds identified from camera trap images for all sites was 32 species. Small mammals of the orders Insectivora (with the exception of the moon rat, *Echinosorex gymnurus*), Scandentia, Dermaptera, Chiroptera and Rodentia (with the exception of porcupines) were omitted from this analysis. There were many records of mouse deer that could not be positively identified; hence, they were grouped under the genus *Tragulus*. The lesser mouse deer (*T. kanchil*) and the greater mouse deer (*T. napu*) both occur in Borneo. The highest number of species (N = 30) was recorded at the Apan Malat site, followed by Apan Sebedi (N = 23) and Apan 11 (N = 22). The highest number of carnivore species (N = 14) was also recorded at the Apan Malat site (Fig. 9.2). Approximately half of all species documented in the respective salt lick sites were recorded visiting the salt lick itself. The number of species recorded at the salt licks was 12 in Apan 11, 15 in Apan Malat and 11 in Apan Sebedi (Table 9.2). Overall, 19 species were documented visiting the salt licks, accounting for 59.4% of the total number of species recorded (Table 9.3).

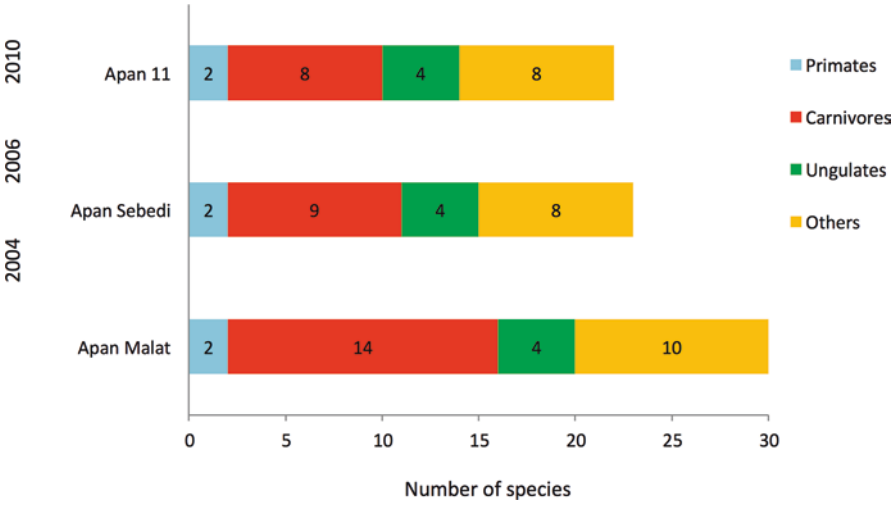


**Fig. 9.2** Number of species recorded using camera traps in three salt lick plots
*Note*: The year associated with each plot refers to the time the surrounding area was last logged

**Table 9.2** Number of species recorded in each sampling plot

| | Apan 11 | Apan Malat | Apan Sebedi | All plots combined |
|---|---|---|---|---|
| Total number of species recorded in entire plot | 22 | 30 | 23 | 32 |
| Species recorded at each salt lick | 12 (54.5%) | 15 (50.0%) | 11 (47.8%) | 19 (59.4%) |

**Table 9.3** Species recorded at each salt lick

| | Common name | Scientific name | Apan 11 | Apan Malat | Apan Sebedi |
|---|---|---|---|---|---|
| Insectivores | Moon rat | *Echinosorex gymnurus* | – | ✓ | – |
| Primates | Long-tailed macaque | *Macaca fascicularis* | ✓ | – | ✓ |
| | Pig-tailed macaque | *Macaca nemestrina* | ✓ | ✓ | ✓ |
| Pangolins | Pangolin | *Manis javanica* | ✓ | – | ✓ |
| Rodents | Malayan porcupine | *Hystrix brachyura* | – | ✓ | ✓ |
| Carnivores | Sun bear | *Helarctos malayanus* | ✓ | – | – |
| | Malay civet | *Viverra tangalunga* | ✓ | – | ✓ |
| | Banded linsang | *Prionodon linsang* | – | ✓ | – |
| | Common palm civet | *Paradoxurus hermaphroditus* | ✓ | ✓ | – |
| | Banded palm civet | *Hemigalus derbyanus* | – | ✓ | – |
| | Otter civet | *Cynogale bennetti* | – | ✓ | – |
| | Short-tailed mongoose | *Herpestes brachyurus* | ✓ | ✓ | ✓ |
| | Borneo bay cat | *Catopuma badia* | – | ✓ | – |
| Ungulates | Bearded pig | *Sus barbatus* | ✓ | ✓ | ✓ |
| | Mouse deer | *Tragulus* spp. | ✓ | ✓ | ✓ |
| | Muntjacs | *Muntiacus* spp. | ✓ | ✓ | ✓ |
| | Sambar deer | *Rusa unicolor* | ✓ | ✓ | ✓ |
| Cuculiformes/ cuckoos | Bornean ground cuckoo | *Carpococcyx radiceus* | ✓ | ✓ | – |
| Galliformes/ pheasants | Great argus | *Argusianus argus* | – | ✓ | ✓ |

### *9.4.1 Visits to Salt Licks*

Ungulates were the most frequently recorded species at salt licks, accounting for 80.7% of the 931 records from all salt licks. The sambar deer (*Rusa unicolor*) accounted for 46.9% of the 931 images recorded from all salt licks combined,

**Table 9.4** Number of images for the most commonly recorded species at salt licks

| Ranking | Species (Common name) | Apan 11 | Apan Malat | Apan Sebedi | Total |
|---|---|---|---|---|---|
| 1 | Sambar deer | 293 | 138 | 6 | 437 |
| 2 | Bearded pig | 35 | 56 | 59 | 150 |
| 3 | Muntjacs | 104 | 1 | 9 | 114 |
| 4 | Pig-tailed macaque | 22 | 15 | 72 | 109 |
| 5 | Mouse deer | 7 | 5 | 38 | 50 |
| 6 | Malayan porcupine | – | 4 | 29 | 33 |
| | Total for all records | 472 | 234 | 225 | 931 |

followed by the bearded pig (*Sus barbatus*) at 16.1% and muntjacs (*Muntiacus* spp.) (Table 9.4). There were 109 records (11.7%) of one primate species, the pig-tailed macaque (*Macaca nemestrina*).

## 9.5 Discussion

Natural salt licks are important sites visited by many wildlife species. In this study, at least half of the species recorded up to 2 km from the site actually visited the salt lick. Sambar deer and bearded pigs had the highest visitation rates. Studies in Sabah have also recorded similar patterns, with sambar deer and bearded pigs representing the top two species most frequently visiting salt licks (Matsubayashi et al. 2007). Camera trap recordings actually show that sambar deer, muntjacs and mouse deer visited salt licks to drink from water deposited there. Bearded pigs were also recorded burrowing at salt licks to forage. These results indicate the amount of use and hence the importance of salt licks for ungulates.

The high number of occurrences of sambar deer and bearded pigs may in fact reflect the high number of these species in the study area. Tracks of sambar deer, muntjacs and bearded pigs were frequently observed throughout the study area. Interviews conducted with the local communities revealed that the bearded pig was the most hunted species with high hunting success rates. The other species commonly hunted was sambar deer. There is no restriction on subsistence hunting for local communities residing inside the study area, although the rules of the National Parks and Nature Reserves Ordinance 1998 and Wild Life Protection Ordinance 1998 do apply to them, and these prohibit the hunting of both totally protected and protected species (National Parks and Wildlife Division 1998a, b).

Hunting pressures may have effects on the behaviour of wildlife, particularly species that are commonly hunted. Animals may come out less often or spend shorter amounts of time foraging. Sambar deer and muntjacs, for instance, have lower detection probabilities in Apan Malat as compared to Apan 11. Apan Malat is situated closer to villages and is more easily accessible, and therefore hunting may be more prevalent (Table 9.5). On the other hand, recently logged sites have a more

**Table 9.5** Access to Apan Sebedi, Apan Malat and Apan 11 and levels of hunting pressure

| Zone | Direct distance (km) from: | | Road access by local people | Level of hunting activities |
|---|---|---|---|---|
| | Main logging road | Nearest settlement | | |
| Apan Sebedi | 8 | 9 | Good, 30 min from main road by vehicle | Low |
| Apan Malat | 1 | 5 | Very good, 5 min from main road by vehicle, also accessible on foot | High |
| Apan 11 | 3 | 3 | Poor with restricted access, accessible on foot only | Very low |

open canopy, a condition that encourages lower canopy and ground vegetation to regenerate. Such locations become favourable to browsers. Future analyses will determine the probability of occupancy by taking into account other habitat variables.

Eight of the 14 species of carnivores (57%) recorded from this survey visited salt licks. Hisashi Matsubayashi et al. (2007) recorded 13 species (87%) of all carnivores visiting salt licks. The high percentage indicates that salt licks also have important ecological roles for carnivores. Whether carnivores visit salt licks for their nutrient uptake or to prey on other animals is not known, as such studies have not yet been carried out.

In older logged-over forests that have been left to recover, the composition of wildlife species was higher than in recently logged sites. Although ungulates were recorded in all sites, older logged-over forests contained greater numbers of carnivore species. As carnivores are species at the top of the food chain, their presence can be used as an indication of the general health of the forest. However, it must be noted that this study was conducted in a forest concession which practises sustainable forest management and employs RIL methods. Because of the prescriptions and guidelines that are currently in place, such as the need for a detailed harvesting plan to minimise impacts on the environment, annual cutting limits that determine the quota of logs that can be extracted, as well as the creation of stream bank reserves and the preservation of high conservation value forests, the conditions of the logged-over forest may have remained favourable for wildlife to persist. The most significant finding is the presence of the endemic Borneo bay cat (*Catopuma badia*) in the riparian habitat of Apan Malat 7 years after logging ceased (Hon 2011). This result demonstrates the importance of creating and protecting stream bank reserves.

## 9.6 Conclusion

Salt licks are important habitat sites for wildlife. At least 50% of the wildlife recorded in the ASDU visited salt licks. The period of time since logging also affected the species composition, with older logged-over sites containing a higher

number of species, including carnivores. The impacts of anthropological factors such as hunting pressure were evident in all sites and these may affect the behaviours of species that are commonly hunted. The management of wildlife and key habitat sites must take into consideration the protection of important sites such as salt licks. Riparian vegetation may provide a refuge for wildlife, particularly after the interior forests are affected by logging. Forest recovery programmes make a crucial contribution towards sustaining wildlife populations in production forests. Sound forestry practices that engage in RIL methods are important for the long-term survival of wildlife populations. Efforts must be enhanced to make sustainable forest management practices a critical and mandatory component for all logging operations in Sarawak.

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